

AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1-40. (Cancelled)

41. (Currently Amended) A method for managing a data storage system, comprising:

configuring a first cache to perform at least one of the operations of retrieving data from and storing data at a first range of logical addresses (LAs) in a storage device;

configuring a second cache to perform at least one of the operations of retrieving data from and storing data at a ~~first part of the first~~ second range of LAs and redundantly storing the data in the first range of LAs;

configuring the first cache to redundantly store the data in the second range of LAs;

configuring ~~one or more third~~ a plurality of caches to perform at least one of the operations of retrieving data from and storing data at a ~~second~~ remaining range of LAs in the storage device and redundantly storing the data in the remaining range of LAs among the plurality of caches; ~~[[,]] the first, second, and third caches being implemented in three separate physical units, comprising software, and adapted to function substantially independently of each other;~~

~~detecting an inability of the second cache to retrieve data from or store data at the first part of the first range of LAs~~ that the second cache is inoperable; and

reconfiguring ~~at least one of the one or more third~~ the plurality of caches to perform ~~the~~ at least one of the operations of retrieving data from and storing data at the ~~first part of the first~~ second range of LAs in response to the ~~inability~~ inoperability while continuing to perform at least one of the operations of retrieving data from and storing data at the ~~second~~ remaining range of LAs; and

reconfiguring the plurality of caches to redundantly store the data in the first range of LAs in response to the inoperability while continuing to perform at least one of the operations of retrieving data from and storing data at the remaining range of LAs.

42. (Previously Presented) The method according to claim 41, and comprising configuring one or more interfaces to receive input/output (IO) requests from host processor directed to specified LAs and to direct all the IO requests to the caches which have been configured to perform at least one of the operations of retrieving data from and storing data at the specified LAs.

43. (Previously Presented) The method according to claim 42,

wherein the one or more interfaces comprise a mapping between the first and the second and the one or more third caches and the first and second ranges of the LAs,

wherein the one or more interfaces are adapted to convert the IO requests to one or more requests and to direct the one or more requests to at least one of the first and the second and the one or more third caches in response to the mapping, and

wherein detecting the inability comprises generating a reconfigured mapping between the first and the one or more third caches and the first and second ranges of the LAs, and directing the one or more request to at least one of the first and the one or more third caches in response to the reconfigured mapping.

44. (Previously Presented) The method according to claim 41, wherein reconfiguring the at least one of the one or more third caches comprises processing data in the at least one of the first cache and the one or more third caches so as to restore the first cache and the one or more third caches to a state of full data redundancy.

45. (Previously Presented) The method according to claim 44, wherein processing the data comprises classifying data in the first cache into a plurality of data groups.

46. (Previously Presented) The method according to claim 45, wherein one of the data groups comprises dirty data, and wherein processing the data comprises storing the dirty data at the one or more third caches.

47. (Previously Presented) The method according to claim 45, wherein one of the data groups comprises dirty data, and wherein processing the data comprises storing the dirty data at the storage device.

48. (Previously Presented) The method according to claim 41, wherein reconfiguring the at least one of the one or more third caches comprises retaining an initial configuration of the first cache.

49. (Previously Presented) The method according to claim 41, wherein reconfiguring the at least one of the one or more third caches comprises implementing a minimum redistribution of the first and the second ranges among the first cache and the one or more third caches.

50. (Previously Presented) The method according to claim 49, wherein implementing the minimum redistribution comprises redistributing the first and the second ranges using a consistent hashing function.

51. (Previously Presented) The method according to claim 49, wherein implementing the minimum redistribution comprises redistributing the first and the second ranges using a random number function.

52. (Previously Presented) The method according to claim 41, and comprising providing a system manager which is adapted to configure the first, second and one or more third caches, to detect the inability, and to reconfigure the at least one of the first cache and the one or more third caches.

53. (Previously Presented) The method according to claim 52, wherein providing the system manager comprises incorporating one or more manager processing units into at least one of the storage device, the first cache, the second cache, and the one or more third caches, and operating the one or more manager processing units in a cooperative manner.

54. (Currently Amended) A data storage system, comprising:

a storage device wherein data is stored at logical addresses (LAs);

a first cache ~~which is~~ configured to perform at least one of the operations of retrieving data from and storing data at a first range of LAs in the storage device;

a second cache ~~which is~~ configured to perform at least one of the operations of retrieving data from and storing data at a second range of LAs and redundantly storing the first range of LAs, the first cache further configured to redundantly store the second range of LAs;

~~one or more third~~ a plurality of remaining caches ~~which are~~ configured to perform at least one of the operations of retrieving data from and storing data at a ~~second~~ remaining range of LAs in the storage device, ~~the first, second, and one or more third caches being implemented in three separate physical units, comprising software, and adapted to function substantially independently of each other;~~ and redundantly storing the data in the remaining range of LAs;

a system manager ~~which is adapted~~ configured to detect ~~an inability of that~~ the second cache ~~to retrieve data from or store data at the first part of the first range of LAs, is inoperable~~ and ~~which reconfigures at least one of the one or more third~~ reconfigure the remaining plurality of caches to perform at least one of the operations of retrieving data from and storing data at the first range of LAs and redundantly storing the data in the second range of LAs in response to the inoperable detection. ~~inability while continuing to perform at least one of the operations of retrieving data from and storing data at the second range of LAs.~~

55. (Previously Presented) The storage system according to claim 54, and comprising one or more interfaces which are configured to receive input/output (IO) requests from host processors directed to specified LAs and to direct all the IO requests to the caches which have been configured to perform at least one of the operations of retrieving data from and storing data at the specified LAs.

56. (Previously Presented) The storage system according to claim 55,
wherein the one or more interfaces comprise a mapping between the first and the second and the one or more third caches and the first and second ranges of the LAs,
wherein the one or more interfaces are adapted to convert the IO requests to one or more requests and to direct the one or more requests to at least one of the first and the second and the one or more third caches in response to the mapping, and
wherein detecting the inability comprises the system manager generating a reconfigured mapping between the first and the one or more third caches and the first and second ranges of the LAs, and directing the one or more requests to at least one of the first and the one or more third caches in response to the reconfigured mapping.

57. (Previously Presented) The storage system according to claim 54, wherein reconfiguring the at least one of the one or more third caches comprises processing data in at least one of the first cache and the one or more third caches so as to restore the first cache and the one or more third caches to a state of full data redundancy.

58. (Previously Presented) The storage system according to claim 57, wherein processing the data comprises classifying data in the first cache into a plurality of data groups.

59. (Previously Presented) The storage system according to claim 58,
wherein one of the data groups comprises dirty data, and
wherein processing the data comprises storing the dirty data at the one or more third caches.

60. (Previously Presented) The storage system according to claim 58,
wherein one of the data groups comprises dirty data, and
wherein processing the data comprises storing the dirty data at the storage device.

61. (Previously Presented) The storage system according to claim 54, wherein reconfiguring the at least one of the one or more third caches comprises the first cache retaining an initial configuration.

62. (Previously Presented) The storage system according to claim 54, wherein reconfiguring the at least one of the one or more third caches comprises the system manager implementing a minimum redistribution of the first and the second ranges among the first cache and the one or more third caches.

63. (Previously Presented) The storage system according to claim 62, wherein implementing the minimum redistribution comprises redistributing the first and the second ranges using a consistent hashing function.

64. (Previously Presented) The storage system according to claim 62, wherein implementing the minimum redistribution comprises redistributing the first and the second ranges using a random number function.

65. (Previously Presented) The storage system according to claim 64, wherein the system manager comprises one or more manager processing units which are incorporated into at least one of the storage device, the first cache, the second cache, and the one or more third caches, and wherein the one or more manager processing units operate in a cooperative manner.

66. (Cancelled)

67. (Currently Amended) The storage system according to claim [[66]] 54, wherein the mass storage devices ~~comprise~~ device comprises one or more disks.

68. (Cancelled)

69. (Currently Amended) The method according to claim [[68]] 41, wherein the mass storage devices ~~comprise~~ device comprises one or more disks.

70-73. (Cancelled)